Agricultural Research Institute, Pusa

The Cultivation of Lac in the Plains of India (Tachardia lacca, Kerr)

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PREFACE.

THIS Bulletin is the result of Mr. Misra's work during the past six years, done under my close direction at the beginning but now carried on as part of his special work in the Section. With the exception of the table of plants, taken partly from Sir G. Watt's Dictionary of Economic Products, the work is original, based upon his own experience; it is in no sense compiled from the existing literature which deals with Lac Cultivation in the forest and not in cultivated areas. Mr. Misra treats the subject from a point almost wholly new and only lightly treated in an article in the Agricultural Journal of India, Volume IV, page 258.

This more detailed publication is intended for students, for enquirers and for those wishing for practical instruction in starting in this industry. There is a demand for this kind of information, and I am glad to be able to put forward a practical and accurate Bulletin to deal with the subject.

H. MAXWELL-LEFROY,
Imperial Entomologist.

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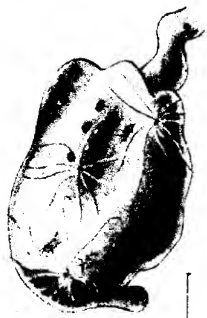

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Tachardia Lacca

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INTRODUCTION.

LAC is a resinous encrustation produced by an insect which sucks the juice of plants and transforms this juice into resin which completely surrounds it. This insect belongs to a group of insects called *Coccidæ*, commonly known as Scale Insects. It is found growing spontaneously on a large number of trees, but is especially grown on the Kusumb (*Schleichera trijuga*), Palas (*Butea frondosa*), Ber (*Zizyphus jujuba*), Peepal (*Ficus religiosa*), Siris (*Albizzia lebbek*) and Babool (*Acacia arabica*).

The cultivation of lac is a very old industry and was known to the ancients. The very name of the Palas tree, Laksh Taru, shows that the early inhabitants of India utilised the tree for propagating the lac insect. In more recent times we find it mentioned in the Ain-i-Akbari where it is said that the lac was collected for making varnishes for use in the Imperial Palaces.

In the beginning it was much collected for the lac-dye it contained. Later on, when the use of resin became known, the demand for lac-dye began to diminish until it was completely displaced by the coal-tar colours. Now-a-days the dye has to be thrown away, and the manufacturers require a stuff which is free from the colouring matter.

Hitherto the industry had been in the hands of local people who rented the trees, removed the lac-bearing branches at the proper

time, scraped the resin, washed it in water and utilised the resin for making bangles and toys. But now it has been possible to cultivate the lac insect artificially on a number of trees, and the directions given herein will enable one to start its cultivation.

Trees on which lac is grown.

The insect is found growing sporadically on a large number of trees—many of which are not found in the plains. Of the many, the following are especially recommended for propagating the lac insect:—

Ber (*Zizyphus jujuba*).
Palas (*Butea frondosa*).
Kusumb (*Schleichera trijuga*).
Peepal (*Ficus religiosa*).
Siris (*Albizzia lebbek*).

[For provincial equivalents of these trees, see the Appendix, pages 28-29.]

Ber.

The Ber is a very hardy tree and grows well in poor soils. It stands pruning well and within a short time sends forth a sufficient number of vigorous, succulent branches to nourish the lac insect. With judicious pruning, the tree can be made to yield an annual crop. At present it is not of much importance, except in the Punjab and the eastern parts of the Central Provinces where it is extensively grown for its fruits. In other parts of India it can be grown on waste lands, field and tank embankments, and profitably utilised for lac cultivation. At Pusa successive crops have been raised on this tree for the past six years, and it is expected that trees carefully treated, according to the directions given hereafter, will yield equally good crops elsewhere.

Palas.

The Palas grows wild over a large area in Bengal, the United Provinces, the Central Provinces, Central India, Sind, and the Punjab. It grows luxuriantly in poor soils and does not require much attention. Hitherto, it has been allowed to run wild for the sake of the wood which is used for fuel, but now it can be utilised profitably for lac cultivation. It stands pruning well and sends forth plenty of

succulent shoots to propagate the lac insect. The lac obtained from this tree is rich in colouring matter, and for this reason is commercially known as '*Rungeen*,' meaning "full of colour." After washing, the resin that is obtained is inferior only to Kusumb lac in quality.

Kusumb.

The Kusumb tree, though not much found in the plains, produces the largest and best kind of lac. The tree grows well at an altitude of 2,000 feet and is generally found growing in moist places, preferably by the side of rivers and *nallahs*. The Kusumb brood-lac if put on Ber and Palas produces a very heavy crop—which should, as far as possible, be reserved for seed. The only disadvantage in this tree is that when once coppiced it cannot be inoculated until two to three years afterwards. Hence an annual crop cannot be obtained from the tree. But this defect is more than counterbalanced by the heaviness and superior quality of the lac produced every second or third year.

Peepal.

The Peepal tree grows all over India. Hitherto whatever lac was found spontaneously growing on the trees was collected by local men, washed and utilised for making bangles. But now it is possible to extend the cultivation by transferring Peepal brood-lac to Peepal trees. The resin obtained from the Peepal tree is pale yellow in colour and is consequently used exclusively for the manufacture of lower grades of shellac or mixed with Palas resin to impart colour. When once a crop is gathered, the tree again becomes fit for inoculation after every two years.

Siris.

The Siris is chiefly grown on roadsides for shade. It produces lac which is equal to Peepal lac in colour and the size of the grains. For extending cultivation, Siris brood-lac should be put on Siris trees, which when once pruned become fit for re-inoculation every two years.

Babool.

Besides these, lac is also found growing on Babool in Sind; but attempts made in the past to transfer the Sind Babool lac to Babool trees in Bihar have not been very successful. One of the reasons why this has been so is, that the climatic conditions prevailing in Bihar are not the same as those to which the insect has been accustomed in Sind.

Arhar or Tur.

Such is also the case with Arhar or Tur which is grown in certain parts of Assam for propagating the lac insect. In the Kamrup District in Assam the seeds are sown on the field embankments, especially of sugarcane, and when the plants are three years old they are inoculated with brood-lac obtained from Arhar plants. Experiments to grow lac on Arhar in other parts of India have failed for the reason that the plants cannot remain on the ground for more than a year and a half on account of the dry heat prevailing in the plains. In Assam the plant continues to grow for three years and produces a heavy crop of lac. Ber brood-lac can be put on to Arhar, but it does not grow fast enough to make the process a success.

Other trees.

Besides these, lac is also found on Litchi (*Nephelium litchi*), Mango (*Mangifera indica*) and the Custard Apple (*Anona squamosa*). But as these are valuable fruit trees they cannot be recommended for breeding the lac insect.

Lac in the Provinces.

Central Provinces.

The largest quantity of lac is obtained from the Central Provinces, and especially from the Chhattisgarh and Nagpore Divisions where the Kusumb tree abounds. It is also collected in the Jubbulpore Division where the Palas tree grows in large numbers. Besides Kusumb and Palas, it is also grown to a limited extent on Ber (*Zizyphus jujuba*), Ghont (*Zizyphus xylopyra*), Gular or Dumar (*Ficus glomerata*) and Peepal (*Ficus religiosa*). The prevailing system of cultivation is that brood-lac is wrapped up in grass and the bundles tied to the branches of trees. When the insects cease to emerge, the bundles are removed and the lac scraped off. A decade ago almost all the stick-lac from the Province found its way to Mirzapore, but now a portion goes to Calcutta and the neighbouring lac factories in the Singhbhum and the Manbhum Districts in Bengal.

Bengal.

Next to the Central Provinces, certain districts in Bengal produce fairly large quantities of lac. At least a large number of people find employment in the Palamau, Hazaribagh, Birbhum, Singhbhum, Manbhum and the Native State of Mourbhunj in cultivating and collecting the lac on Palas and Kusumb trees. It is also grown to some extent in the Murshidabad, Midnapore and Bankura Districts Palas, Kusumb and Ber are the trees on which the lac insect is gen-

erally propagated. The two former are mostly used in the Chhota Nagpore Districts and the districts adjoining thereto, but Ber is chiefly used in the Murshidabad and Birbhum Districts. Round about Pakur and Raghunathganj in the Murshidabad District hundreds of Ber trees may be seen especially grown on the field embankments, carefully pollarded and inoculated with the lac insect. Here the system of cultivation is much the same as in the Central Provinces. Brood-lac is cut a week before the emergence of the young insects, wrapped up loosely in grass, and tied on to the branches of trees. When the emergence is at an end the bundles are removed and the lac scraped off. In the Murshidabad District small sticks locally called *anties*, varying in length from 9 inches to 13 inches, are tied to the trees in such a way that their ends touch the branches. These are removed when the insects cease to emerge, and the lac removed with knives.

Assam.

In this Province lac is mostly grown in Lower Assam, especially in Goalpara, Kamrup and parts of the Nowgong District. The insect is mostly propagated on Arhar or Tur—*Cajanus indicus*—(Garro, *Miri Mah;* Lushai Hills, *Behliang*) and on three to four species of *Ficus*, especially the Pakari (*Ficus cordifolia*), Ahat (*Ficus religiosa*) and Bar (*Ficus altissima*). Bogari or Ber (*Zizyphus jujuba*) is not much used for lac. The cultivators generally put either whole branches or pieces of them wrapped in grass on the trees. In the case of Arhar or Miri Mah, small brood-lac sticks, each 6 inches to 8 inches long, are tied to the stem of each plant with plantain bast. When the young insects cease to emerge the sticks are removed and the resin scraped with knives.

United Provinces.

Very little lac is grown in these Provinces. Attempts made in the past to extend the cultivation have not been very successful. Some lac is collected in the Saharanpore, Bahraich, Kheri and Mirzapore Districts. The trees on which lac is generally found growing are:—Palas, Kusumb, Ber, Peepal, Bad or Bar, Gular (*Ficus glomerata*) and Pakur (*Ficus infectoria*). The collection is mostly done by Manihars who rent the trees and remove the resin.

Punjab.

The lac insect is well distributed in certain districts, but so far no systematic cultivation has been practised except in the Hoshiarpore and

Gurdaspur Districts. The Ber tree is extensively grown round homesteads for its fruits and is especially abundant in the Jhang District. Besides Ber, some lac is also found on Kikar (*Acacia arabica*), Siris (*Albizzia lebbek*) and Peepal (*Ficus religiosa*).

Bombay.

Very little lac is grown in this Presidency excepting in Sind where the lac insect flourishes on the Babool trees which grow luxuriantly on the Jamrao Canal and its distributaries. The quantity of lac collected in the Thar and Parkar District finds its way to Karachi from whence it is exported. Besides Babool, lac is also found here on Kandi (*Prosopis spicigera*), Siris (*Albizzia lebbek*), Tamarisk (*Tamarix gallica*) and Bar (*Ficus bengalensis*). But the amount collected from these is not half so large as that collected from the Babool trees annually.

Madras.

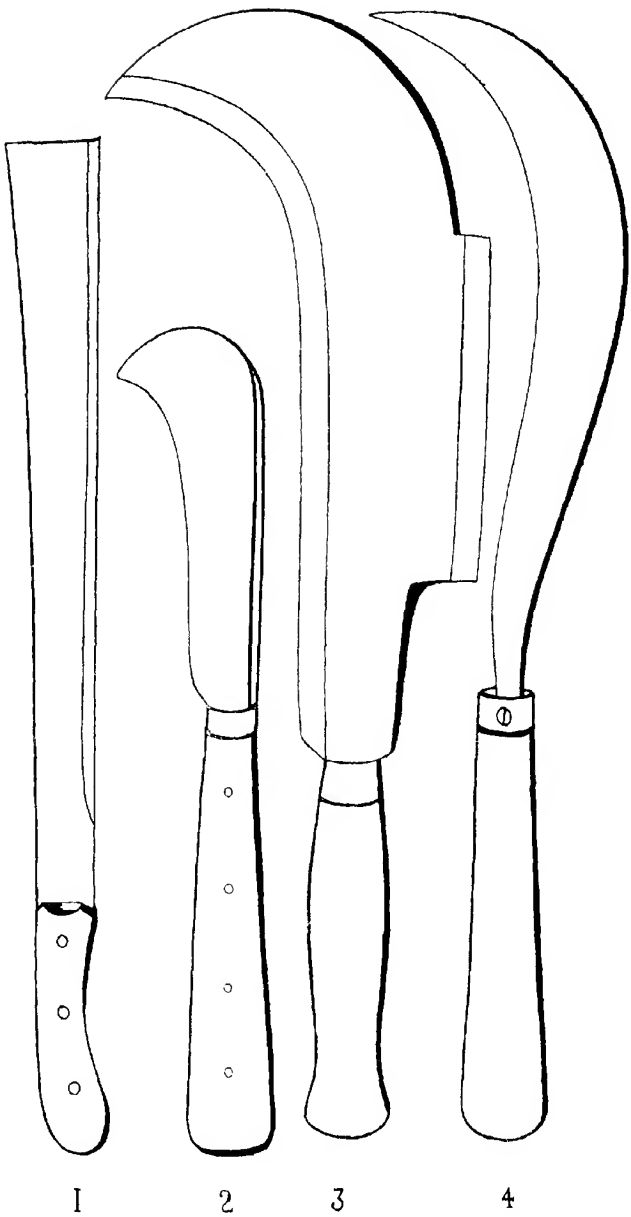
So far as is known no lac is grown in this Presidency. Possibly some is found on Jala a species of Sāl (*Shorea talura*).

Localities suitable for lac cultivation.

Places which are neither very hot nor very cold and where the annual rainfall is about 30 inches are suitable for lac cultivation. Moisture is a great necessity for the successful development of the insect, but if it is in excess it affects the crop injuriously. Dry, arid places are to be avoided in starting the cultivation. Extremes of heat and cold retard the growth of the insect. With heat the resin melts, the air holes through which the insect breathes are blocked and it dies of suffocation. As a test of the suitability of the place for lac cultivation, only a few trees should be inoculated in the beginning, and if on these the lac flourishes throughout the year the operations may be extended or otherwise given up; for it must be remembered that the success or otherwise of lac cultivation depends very much upon climatic conditions.

Instruments and other accessories required for the work.

The instruments and other accessories required to start and carry on the work are very few. Only knives as shown on Plate II, some plantain bast or jute or san-hemp fibre are all that are required. In the beginning a small quantity of brood-lac is also required to



VARIOUS FORMS OF PRUNING KNIVES.

1. A good pattern, a heavy straight blade for pruning.
2. A tea-pruning knife for trimming cut-ends.
3. A bill-hook for very heavy work on big trees.
4. The ordinary Indian pattern made in the bazaars at a cost of eight annas.

put on the trees. A straight-edged knife (Fig. 1, Plate II) is required to prune and cut the lac-bearing branches which are away from the stem or the main branches. A curved or double-edged knife (Fig. 3, Plate II) is required to dress the trees and to cut the lac-bearing branches into lengths varying from 9 inches to 11 inches. The other knife (Fig. 2, Plate II) is required to trim the lac-bearing branches before cutting them into pieces, and to scrape Ber lac. The knives should, if possible, be of steel to withstand rough handling and must have a sharp edge. Their outer edge should, if possible, be thick to impart force and to make clean cuts. A lighter knife is apt to slip off while pruning tough branches and to produce jagged ends, which would have to be dressed to prevent water lodging and setting up decomposition. Knives of the pattern given on Plate II could be easily made locally or procured from any hardware merchant in Calcutta or Bombay at one rupee each.

Besides these, a few bamboos are also required on which to aërate the brood-lac sticks prior to their being put on the trees. If, however, large Ber trees are to be inoculated, *Shikias* (as figured below) will be found very convenient for hauling quantities of

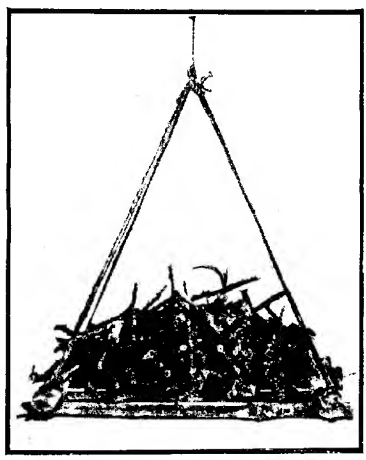


Fig. 1.

Shikia for taking brood-lac up the trees.

brood-lac sticks up the trees at the time of inoculating them. In

the case of Palas, if a large number of trees are to be inoculated, bamboo receptacles (as figured below) will be found very conveni-

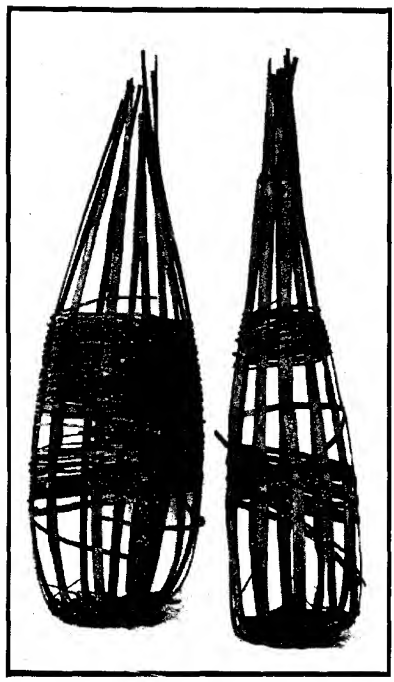


FIG. 2.
Bamboo receptacles for inoculating Ber and Palas trees.

ent for putting on the brood-lac expeditiously.

Time and labour required to carry on the work.

The emergence of young insects takes place twice a year, and a fortnight before each emergence the trees have to be pruned and got ready to facilitate inoculation. A week in June and a week in October is all that a cultivator of 20 Ber and 60 to 80 medium-sized Palas trees has to devote to the work. To carry on the work successfully either he will have to seek the co-operation of a member of his family or engage temporary labour to finish the work in proper time. If, however, a large number of Ber, Palas or Kusumb trees are to be

Plate III.

FIG. 3.
A finely formed tree trunk.

FIG. 4.

inoculated, regular gangs of coolies will have to be engaged to finish the work. From past experience it has been found that a gang of four coolies working eight hours per day is capable of inoculating 70 to 100 Palas trees of medium size. In this work, it must be borne in mind, it is essential that the work of cutting, removing and putting on the brood-lac must be done in proper time. A week's delay produces unsatisfactory results.

Crops during the year.

There are two crops during the year. That which is gathered during June-July is called the Baisakhi crop from the name of the month Baisakh, in which the crop is generally collected, and the other the Katiki—from Kartik, the month in which the crop is gathered. The former is in some localities also called the 'Rangeen' on account of the stick-lac—especially Palas—containing a large amount of colouring matter. Of the two, the Baisakhi crop is the larger and better. It takes nearly eight months and a half to mature and in consequence the proportion of resin to lac-dye is greater than in the following Katiki crop. Besides, it is partly immune from the attacks of predators and parasites as it passes through winter during which time most of the injurious insects remain dormant in one stage or the other. The Katiki crop takes only three months and a half to mature, and in consequence the proportion of resin to lac-dye is much less than in the previous Baisakhi crop. In some years the crop is so much attacked by predators and parasites that it is a partial failure. For these reasons the growers in Bengal and the Central Provinces—who produce the largest and best kind of lac—reserve most of their Katiki (winter) crop for seed and do not sell it.

From a tree only one crop is obtained yearly. In the beginning the trees require to be pruned, but later on the removal of the lac-bearing branches is a pruning of the trees. If, however, it is desired to obtain two crops during the year, the trees to be inoculated should be divided into two groups. The trees in the first group are to be pruned in February and inoculated in the following June, whilst the trees in the second group or block are to be pruned for the following October inoculation. In October the crop from the first group is gathered and put on to trees in the second group which have already been pruned for the purpose.

Pruning trees.

Before starting cultivation, care should be taken that the trees on which lac is intended to be grown have sufficient tender branches to enable the lac insect to establish itself. If this is not so, the trees should be pruned carefully. This is especially necessary in the case of the Ber tree which responds to careful pruning by sending forth a large number of vigorous and succulent shoots. The Palas does not ordinarily require pruning, and the same is the case with the Kusumb. For pruning Ber trees two kinds of knives are required (Figs. 1 and 2, Plate II), and these must be very sharp and thick at the outer edge to impart force to the cuts. If one is starting cultivation on Ber trees for the first time, the trees should be pruned when they are dormant and the sap is not flowing upwards. In Northern India this is preferably done in the beginning of February for the June inoculation and in the beginning of June for the following October inoculation. At the time of pruning all the wiry, gnarled and distorted branches, as well as the dead ones, must be cut away clean. All the stumps of branches which show little signs of healing over should be carefully dressed and the ends either tarred or plastered over with a well-kneaded mixture of soft earth and cowdung. If, during the process of pruning, the branches get notched or otherwise badly lacerated, the ends should be carefully dressed to prevent insects killing the tree or water lodging in the cavities. A carefully pruned tree quickly sends forth a number of vigorous shoots, whilst a badly or carelessly pruned tree either dies or sends forth only weak, straggling, wiry branches. (Plate III.) Strong growing plants should be lightly pruned, whilst old and decrepit trees should be headed back to induce production of new wood which renews the vitality of the tree. Heavy pruning should be followed by light pruning. In Northern India it has been found that heavy pruning of old and weak Ber plants is required in the beginning. Thereafter no pruning, excepting that which is automatically done by the removal of the lac-bearing branches every season, is required for eight to ten years. It is true that the continuous propagation of the lac insect considerably lowers the vitality of the tree on which it grows, but this loss can be made up by judicious pruning which has the same effect as manuring. The photographs (Plates IV and V) show the stages in the growth of a heavily pruned tree, which six months after pruning was ready to be inoculated. The effect of pruning as well

FIG 5.
An old Ber tree severely pruned.

FIG. 6.

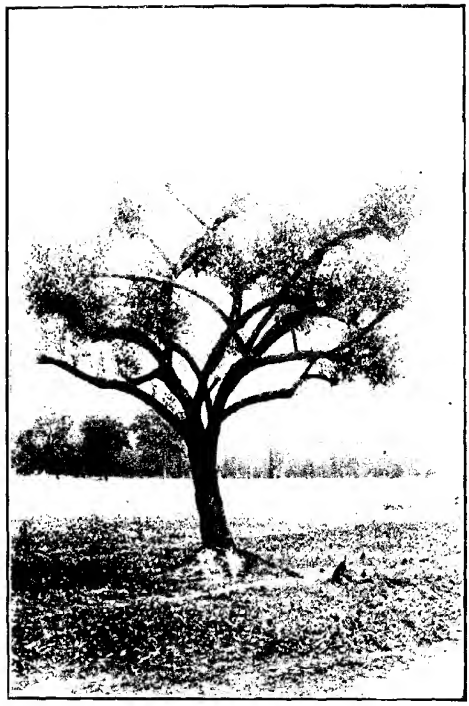


FIG. 7.
The same tree showing growth of healthy shoots at ends of branches.

FIG. 8.

as the necessity for it depends greatly upon the locality and the climatic conditions prevailing therein.

Life history of the lac insect.

For successfully working lac, one must be familiar with the life history of the insect that produces the lac.

On examining a twig covered with lac one will find a number of resinous globules adhering closely to the stem. These are the full-grown females containing fertilised eggs. When the eggs mature, small, deep red insects come from a hole situated at the posterior end of the body of the female and begin to wander about in search of suitable places to fix themselves. This happens twice in the year. Throughout the country the local dates of emergence of the tiny insects vary considerably according to the food-plant on which they grow and the climatic conditions prevailing in the locality. The following are the approximate dates of emergence of the young insects in the different Provinces:—

Province.	Tree.	Baisakhi crop.	Katiki crop.
I.—Bengal—			
(1) Southal Parganas.	Kusumb	May-July	October-January.
	Palas and Ber	March-May	August-October.
(2) Palamau	Kusumb	July-August	October-January.
	Palas	May-June	August-October.
(3) Murshidabad	Ber	June-July	September-October.
(4) Birbhum	Ber	March-May	September-October.
II.—Central Provinces	Kusumb	July-August	December-February.
	Palas	June-July	September-November.
III.—Assam	Arhar	May-June	October-November.
IV.—United Provinces	Palas	June-July April-May (Bundelkhand).	October-November.
V.—Punjab	Ber	May-June	October-November.
VI.—Bombay (Sind)	Babool	April-June	November-January.
VII.—Madras	Sāl (*Shorea talura*)	March-April	October-November.

At the time of emergence the larvæ (young insects) are one-twenty-fifth of an inch long, deep red in colour, with three pairs of legs, a pair of black eyes, a pair of feelers (antennæ) with a pair of long, thin hairs at the tip (Fig. 3, Plate I), a small bent tube and a pair of thin hairs at the end of the body. They are very sluggish

in their movements and wander about until they come upon a suitable spot to fix themselves. When once fixed they cannot be removed. They are gregarious in habit and have mostly been seen to move upwards and then to settle down on tender branches in places protected from the wind. At this time there is very little difference between the young male and female insects. After fixation they thrust their beak into the tissues of the stem and begin feeding. The sap thus taken into the body is greatly transformed and is given out uniformly through pores all over the body in the form of resin, which after a few days completely encases them. They then moult and begin to feed actively. If the young insect is a female it remains fixed once for all. If a male, there is a considerable modification of the legs, eyes, feelers and the anal tube. After a fortnight the male and the female larvæ (young insects) can be distinguished by the peculiar shape of their cells within which they remain incarcerated. The male cell (Fig. 7, Plate I) is elongate, with a pair of holes at the anterior end from which thin whitish hairs come out. The female cell (Fig. 5, Plate I) is nearly globular with an irregular margin, with three holes on the top—two situated at the fore part and the other at the hind part. From these holes, thin, long, whitish hairs project, which carry air to the insect within the resinous cell. Thus both the cells continue to grow until August (in the June inoculation) when wingless males come out. From the October inoculation both winged and wingless males emerge (Figs. 8 and 9, Plate I). At this time the wingless males must not be mistaken for the young insects. On this point mistakes have been made in the past and are likely to be made again. Hence, to avoid such accidents, the following distinguishing characteristics between the two are given here (Figs. 3 and 8, Plate I):—

Young insect.	Wingless male.
a—One-twenty-fifth of an inch long.	*a*—Nearly one-twelfth of an inch long.
b—A pair of black eyes.	*b*—A pair of black divided eyes.
c—Feelers (antennæ) eight jointed, a pair of fine hairs at end of fifth joint.	*c*—Feelers (antennæ) eight jointed, joints nearly equal and hairy.
d—Abdomen indistinctly ringed.	*d*—Abdomen distinctly ringed into eight segments.
e—Legs delicate.	*e*—Legs stout.
f—Tube at end of body indistinct.	*f*—Tube at end of body long, slightly bent apically.
g—A pair of thin hairs at end of body.	*g*—A pair of long, stout hairs at end of body.

LAC ON BER.

On the left a twig, showing the young settled down shortly after inoculation. In the middle, half-grown healthy lac showing the characteristic white fluffy appearance.

On the right, mature lac from which the young have emerged. In the middle, is a single hole from which has emerged the mother of a caterpillar that feeds on lac. (All natural size.)

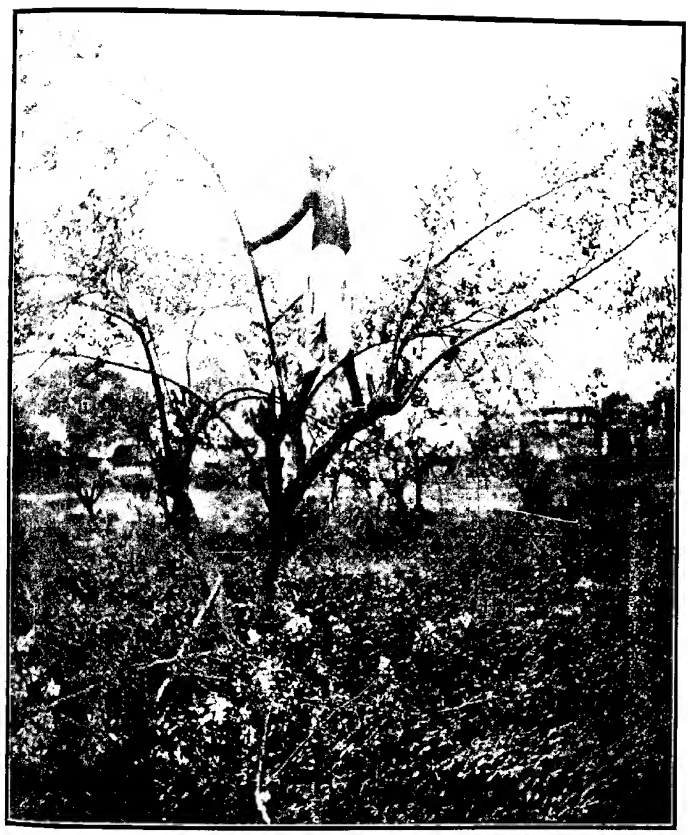


FIG. 9.
Man cutting down lac-bearing branches.

Fig. 11.
Palas tree inoculated with Bamboo receptacles.

The wingless, as well as the winged, males walk sluggishly over the resinous cells fertilising the females, but the latter form is especially meant to complete the dispersal. After fertilisation the females develop fast. They take in more sap, consequently exude more resin and swell up. At this time a copious amount of sugary liquid—technically known as "honey-dew"—is excreted and this, falling on the leaves, branches and the ground below trees, develops a black fungus. The respiratory hairs lengthen out and the branches covered with lac appear white from a distance. If, however, the characteristic whiteness is not seen, it is to be feared that the females have been killed either by ants or by heat. Normally the female continues to grow for eight months and a half in the October inoculation and for three months and a half in the June inoculation. Three weeks before the emergence of the larvæ she ceases to feed and her body shrinks as eggs are laid. If, therefore, the lac-bearing branches be cut a fortnight before the coming out of the young ones no harm is done to the brood-lac on the branches of trees. This fact is of great use in sending brood-lac to distant places by post, in arranging exchanges of brood-lac from different places and in carrying out the inoculation of trees on a large scale. When the young insects again swarm out, they wander about from 12 to 20 hours or even more and then settle down on the branches. The emergence continues for over five weeks, but is at its height during the first three weeks.

Life cycle throughout the year.

In Northern India the life cycle of the lac insect is approximately as follows:—

Starting with the Baisakhi (summer) crop the young insects swarm out by the middle of June. On coming out they wander about and ultimately fix themselves on the tender branches and begin exuding the resin which completely surrounds them. At first there is very little difference between the young male and female insects, but a fortnight after fixation the cells containing them become distinguishable. The male cell is elongate, the female cell is roundish. Both continue to grow until August when the wingless males emerge. These fertilise the females and die. The female then begins to grow rapidly, takes in more sap and exudes more resin. Thus she continues to grow until the middle of September when she stops feeding, lays eggs and continues to shrink until she also dies. (Plate VI.)

By the beginning of October the young ones again swarm out and continue to do so for over five weeks. After wandering about for some time the young ones fix themselves, suck the juice and the resin is then given out through pores all over the body and surrounds them completely. By the end of January wingless as well as winged males emerge, fertilise the females and die. The female thereafter continues to grow until the beginning of June and then dies. The young ones then again come out by the middle of June and thus complete the life cycle throughout the year.

Preparations prior to inoculation.

The first and most important point to know in lac cultivation is the local date of emergence of the young insects. In Northern India the local dates vary from place to place, as has been mentioned above. The best way of knowing these in different places is to observe the emergence during the year from May-August for the Baisakhi (summer) crop, and from October to January for the Katiki (winter) crop. Having once determined these, they will be found to remain fairly constant for the locality from year to year. The next thing is to cut the lac-bearing branches a fortnight before the probable emergence. This enables one to inoculate a large number of trees, to exchange brood-lac from distant places, and to sell the remainder not required by the lac-breeder for his own use.

If a large number of Ber trees are to be inoculated, a fortnight before emergence is the most convenient date for cutting the brood-lac. If a smaller number of Ber trees are to be inoculated, the cutting may be deferred until a week later. To remove the lac-bearing branches a man goes up the tree with a long, straight, sharp knife (Fig. 1, Plate II) and cuts the branches (Plate VII), making clean cuts only, and dressing the ends of those which accidentally get notched or otherwise lacerated. Another cooly stands below the tree and removes such portions of the branches as do not bear any lac. Having dressed the branches, he passes them on to a third cooly who sits near the tree and cuts them into lengths of 8 to 11 inches with the outer blade of the heavy bent knife (Fig. 3, Plate II). While cutting he also examines the lac-bearing branches, and if any are found damaged or containing predaceous caterpillars he keeps them aside. When all the branches have been collected and cut into lengths of 8 inches to 11 inches, they are taken home and spread

on rows of bamboos to aërate in a cool, airy place, preferably the verandah of a house.

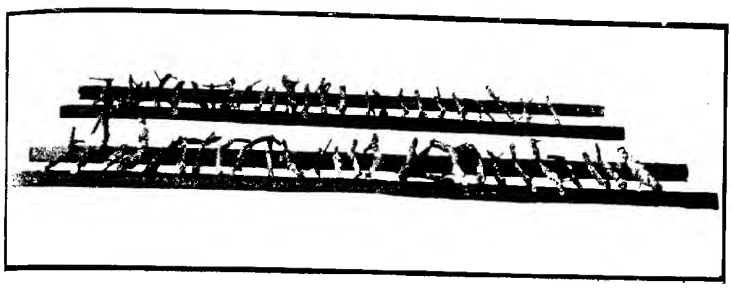


FIG. 10.
Brood-lac sticks aërating on Bamboos.

The sticks are then occasionally examined and turned over to aërate them well. Twelve to fourteen days after, when a few, tiny, deep red insects are seen crawling over the sticks, they are taken to the trees already pruned for the purpose and tied to their branches either with plantain bast, jute or san-hemp fibre or any other cheap fibre. When large Ber trees are to be inoculated it is found convenient to haul up the sticks in *Shikias* (Fig. 4). In inoculating a number of Palas trees, it is not necessary to cut the lac-bearing branches into pieces. All that is required is to cut off the branches a fortnight before the emergence of the young insects, and to remove such portions thereof as do not bear any lac. Having done this the branches are either to be kept for a day or two in a cool, shady place to aërate or put directly on to fresh trees. By cutting the branches just when the young insects are seen crawling over them much of the brood-lac is lost, as the ends of branches being then green, the insects fix themselves there and are thus lost. Where labour is dear, bamboo receptacles (Fig. 5) will be found very convenient for putting on the brood-lac over a large number of Palas and Ber trees. They can easily be made locally and can be had at twelve annas per hundred, or even cheaper if obtained in numbers. Each receptacle consists of 12 to 16 slips of bamboo: each slip is 32 inches long and $\frac{3}{8}$ of an inch broad. They are loosely woven at the bottom and again at 7 to 8 inches from the top—which remains open. Twelve to fifteen brood-lac sticks are put in each receptacle, and five, eight, ten, fifteen or even twenty of these are easily put on the Palas trees

according to their size. (Plate VIII.) Before putting them on, their mouths are tied with string and another small piece is attached at the bottom to keep them in position. When the larvæ hatch out, they easily pass through the string to the branches and fix themselves there on the succulent portions. When the emergence is at an end, the receptacles are removed, the sticks taken out and the lac scraped off.

Inoculation of trees.

Inoculation is the process of tying brood-lac sticks to the branches of pruned trees in such a way that their ends touch the branches. This is usually done either ten to twelve days before the emergence of the young insects or when they have actually begun to swarm out. The object of doing this is to transfer the young insects from the brood-lac to the tender branches of the pruned trees where they fix themselves and begin exuding resin. In the days when prices for stick-lac were high, and the lac-dye (colouring matter obtained by washing the stick-lac with water) was a marketable product, the growers used to collect almost all the lac before the emergence of the larvæ so as to get the largest quantity of lac-dye, and in consequence very little brood-lac was actually left on the trees for the following crop. This led to a heavy loss in the quantity of brood-lac available for seed and a state would soon have been reached when lac would have become scarce, had it not been for the aniline colours which totally displaced the use of the lac-dye as a colouring agent. Now with the fall in prices, the cultivator's attention should be drawn to preserving sufficient quantities of brood-lac and to improved methods of cultivation, which should result in the production of the better quality of lac required by the consumer. The first and most important point is to obtain and use only healthy brood-lac and to reject such as has been damaged by ants, heat, predaceous caterpillars and parasites. (Plate IX.)

Having done this, the next point is to attend to the details of inoculation. Only so much brood-lac should be put on a tree as may be able to grow on it successfully. To inoculate a tree heavily is to kill it and thereby lose the brood-lac. The sticks should be tied to branches with plantain bast, jute or san-hemp fibre in such a way that their ends touch the branches. This is done in three ways:—

Firstly.—Putting a brood-lac stick on each branch in such a way that its ends touch the branch.

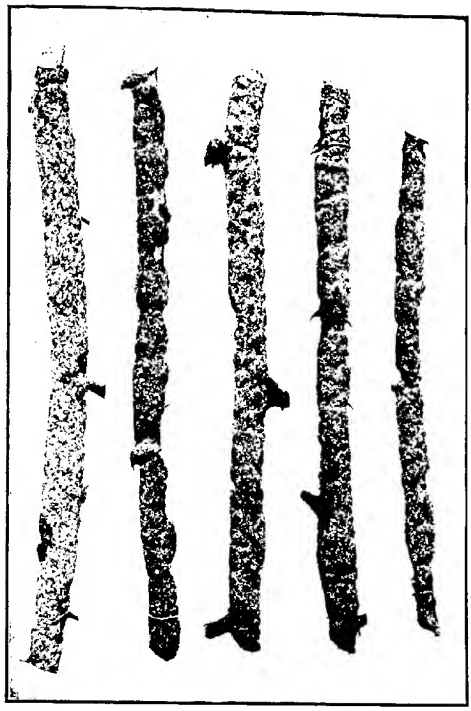


FIG. 13.
Healthy brood-lac sticks.

FIG. 14.

Secondly.—Tying a stick to three or more branches in such a way that it passes through two or more, and that its ends touch the two terminal branches.

Thirdly.—Fastening a number of sticks at the base of a branch and tying them with thread or some fibre in such a way that the ends of sticks touch the stem both ways.

If, however, the sticks get loose, they must be tied again as before, and when, two to three days after inoculation or a little later, the branches appear red from below, the sticks are to be removed and fastened to other pruned trees. Not more than half the lengths of branches are to be allowed to be covered by the young insects. If this is not attended to, the trees suffer from over-inoculation and a poor crop is the result. With a large number of insects on them the branches are unable to respond to the drain on them and they wither prematurely. In some cases when the brood-lac is very healthy the emergence of the young insects is so profuse that within a few hours the greater portions of the branches become red. When such is the case the brood-lac sticks should be removed promptly and put on to other trees kept pruned for the purpose. This is to be repeated till the emergence ceases, when the sticks are to be removed and the lac scraped off. The young insects continue to emerge for over five weeks, but they generally come out in numbers during the first three weeks: afterwards their number rapidly declines. Such being the case, if at the time of inoculation it be raining, or a strong wind be blowing, it is safe to postpone the work until such disturbing factors cease altogether or their force is lessened. It is no good inoculating the trees while it is raining as then the young insects are liable to be washed off the trees. From experiments it has been found that if five Ber trees are inoculated during September-October they will yield sufficient brood-lac during the following June to inoculate 25 to 30 trees.

Cycle of pruning and inoculating.

In Northern India the cycle of pruning trees and inoculating them would be:—

[For the sake of illustration, to obtain a crop annually a cultivator is supposed to have divided his trees into two groups, A and B.]

February 1912 . . . . Prune trees (Group A) and arrange for brood-lac.

June 1912	Put lac on the pruned trees (Group A) and prune trees of Group B for the following October inoculation.
October 1912	Cut lac from trees (Group A) inoculated in June last and put it on trees (Group B) pruned then.
June 1913	Cut lac from trees (Group B) and put it back on the first trees (Group A).

Thus with careful pruning and judicious inoculation the vigour of trees could be maintained for a long time and annual crops taken from them.

The sketch given above is suitable for Ber and Palas trees. For Kusumb and Peepal, the sequence will have to be altered, as these trees, if once pruned either while starting cultivation on them for the first time or by the removal of lac-bearing branches thereafter, become fit for re-inoculation every second or third year according to the locality. This disadvantage, especially in the case of Kusumb, is counterbalanced by the heavy yield and superior quality of the produce obtained every second year. The Kusumb brood-lac is the healthiest and grows well on Ber and Palas.

Cost and yield.

No accurate figures as to cost and yield can be given, since wages and prices of brood-lac vary so much from place to place. In Gaya and its neighbourhood brood-lac is to be had at one to two rupees per seer. At Daltonganj, Palamau and Hazaribagh in Bengal as much could be had for a rupee as could be conveniently bound in a rope a cubit and a half long. In the Murshidabad District 50 *anties* (sticks), each 9 inches to 11 inches long, make up a *Turie* which is to be had for annas eight to a rupee each according to the market rates of stick-lac. In the Birbhum and Singhbhum Districts in Bengal a seer of brood-lac is to be had for a rupee. In the Raipur District in the Central Provinces, a seer of Kusumb brood-lac could be had for a rupee or even less according to the market rates of stick-lac. As regards wages, if the work is done by a cultivator assisted by the members of his family the cost of production is considerably lessened. All that he will require will be to buy brood-lac in the beginning. Subsequently the produce from his trees will enable him to extend the cultivation. The great advantage in this work is its simplicity, the inexpensive-

FIG. 15.
Men scraping Ber lac.

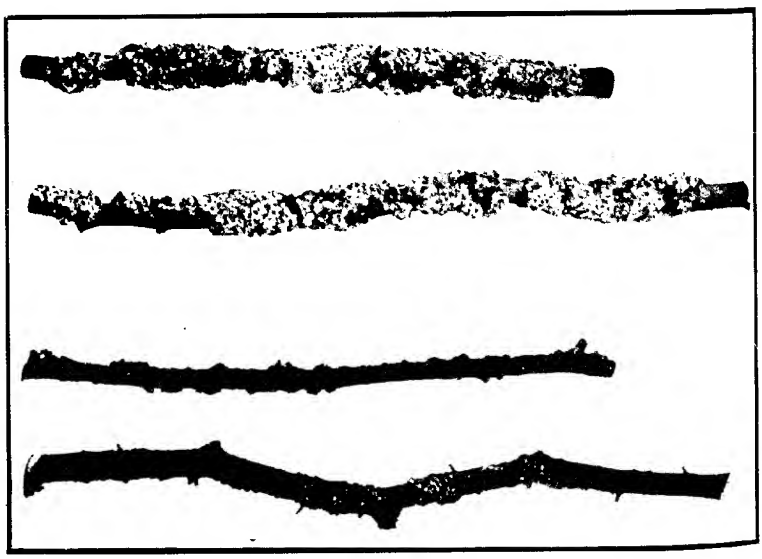


FIG. 16.
1 and 2. Brood-lac sticks free from caterpillars.
3 and 4. Brood-lac sticks infested with caterpillars.

ness of materials required to start and carry on the work, and the non-interference it causes in the agricultural operations throughout the year. To grow lac on 20 Ber trees does not take more than a week in both seasons, and the profit from each tree may be roughly computed to be not less than annas eight. This is so because the present market rates of stick-lac are the lowest ever touched during the past decade. The produce from a Ber tree is generally five to eight times the quantity applied to the tree.

In Bengal, it was found by experiment that the cost of propagating lac on a Kusumb tree was Rs. 5-8-0 and the resulting lac was valued at Rs. 10; so that a profit of Rs. 4-8-0 was obtained per tree. This included the cost of brood-lac, which was obtained from long distances, as well as the cost of inoculating, transferring and scraping the lac. For practical purposes the income per Kusumb tree may be safely reckoned at Rs. 3 and that from a moderate-sized Palas tree at annas eight.

Scraping lac.

When the young insects have ceased to emerge the sticks bearing lac encrustations are removed, brought home and the resin scraped with knives (Figs. 2 and 4, Plate II) in the case of Ber lac (Plate X). For Palas and Kusumb, the resin easily comes off if twisted with the hand and no scraping with knives is required. If, however, the lac-bearing branches have remained unscraped for long, the resin is easily taken off by crushing the sticks with a *Dhenkli*, care being taken that the resin is not ground too fine. As far as possible the resin should be scraped off immediately after removal of the sticks from the trees—otherwise caterpillars spoil it and render it useless for commercial purposes. The scraped material—commercially known as stick-lac—should never be exposed to the sun as then the edges of the cells are likely to melt and turn over, forming compact masses—which is commercially known as agglutinated lac—from which the cost of removing the dye is considerably increased. It should not be kept also in gunny bags after scraping, as then the heat of fermentation spoils the resin and lowers its marketable value. As far as possible the stick-lac should be sold after scraping. If this be not possible, it should be washed, the seed-lac stored and the lac-dye used as manure.

Washing lac.

After scraping, the lac should be thoroughly dried in the shade and sold to the nearest shellac factory or the local agents of these factories. If there be no agent in the neighbourhood or there be insuperable difficulties in disposing of the produce, it should be ground with an ordinary hand-mill and soaked in water for 24 hours. If the quantity is not large it can easily be rubbed with the hands in a stone vat or *Nānd* (an earthen vessel with a wide mouth and a thick bottom) until the colouring matter—commercially known as the lac-dye—is separated. More water is added and the stuff strained through a piece of cloth. The colouring matter is allowed to accumulate in a vessel and the stuff again put back into the vat and briskly rubbed. More water is then added and the washed material again strained. This is continued until no more colouring matter comes out. A little washing soda (Monohydrated Sodium Carbonate) is then lightly sprinkled over the washed product at the rate of 4 chhitaks (8 ozs.) to a maund (40 seers or 80 lbs.) and the whole again rubbed briskly and more water added. By doing so the last trace of the colouring matter is taken out and the resultant washed material is of a beautiful, pale orange colour—which is the seed-lac or *Dāl* of commerce. If an excess of washing soda is added it takes away the wax adhering to the particles of the lac which when warmed becomes very brittle.

In factories, the washing is done in large stone vats placed in a row on a pucca or cemented platform. Ground and sifted stick-lac is put into these vats and soaked in water for 18 to 24 hours. The professional washers then stand upright in the vats and gyrate briskly, taking for their support bamboo poles fixed by their sides. When the material is sufficiently washed the plugs at the bottom of the vats are opened and the washed stuff run out on to graduated sieves placed below the plugs. The colouring matter runs out and accumulates in a large tank especially built for the purpose. The half-washed resin is again put back into the vats and the washing continued until no more colouring matter comes out. The seed-lac is then dried in the sun and graded into granular seed-lac and dust—commercially known as *Gund*. The lac-dye in the tank is then precipitated either with quick-lime, lime-water or oxide of tin.

Washing lac.

A professional washer can wash from one maund to a maund and a half at rates varying from annas four to annas eight a maund. But a cultivator—who is not accustomed to washing—cannot be expected to wash more than 15 seers per day.

A maund (40 seers or 80 lbs.) of Ber stick-lac ground and washed with water will yield 18½ seers of clean seed-lac with 30 to 32 gallons (150 to 160 seers) of workable lac-dye. A maund of Ber stick-lac experimentally crushed and washed gave:—

Before washing.	Srs. ch.	*After washing.*	Srs. ch.
Granular	25 4	Granular	18 8
Small granular and dust .	12 12	Small granular and dust .	10 4
Refuse, sticks, thorns, etc. .	2 0	Lac-dye, etc. . . .	11 4
TOTAL .	40 0	TOTAL .	40 0

The quantity of water required to wash the above was 140 gallons (17½ mds. or as much as could be contained in 35 kerosene tins).

Uses of the lac-dye.

By washing stick-lac with water two things are obtained:—

I. Pure resin commercially known as seed-lac and used for the manufacture of shellac.

II. Lac-dye.

Before the introduction of aniline colours the latter product was extensively used for colouring wool, leather and silk and generally represented the manufacturer's margin of profit.

But now it has to be thrown away and better prices are paid for a material which contains a smaller quantity of colouring matter in it. The dye can still be used for the manufacture of *Alltas* or balls of cotton-wool soaked in concentrated lac-dye and used by Hindu women for colouring the soles of their feet. Besides, it is a rich source of nitrogen and is equal to some of the best oil-cakes in its manurial value. A portion of nitrogen is present in the form of ammonia, while the balance is contained as an albuminous substance. The following analysis by the Imperial Agricultural Chemist, Pusa, of a Bengal sample exemplifies this:—

Specific gravity	1·003
Nitrogen	·014 per cent.
Phosphoric acid	·004 „ „
Potash	·008 „ „

After washing, the lac-dye can be spread over fields and worked into the soil with an ordinary plough. It can also be used for

dyeing eri-silk. The cloth, if previously mordanted with alum, takes a beautiful red colour which is not affected by human perspiration. For dyeing eri-silk take $3\frac{1}{2}$ chhitaks (7 ozs.) of stick-lac free from dirt, pieces of sticks and other impurities, grind it fine and boil it in a seer (2 lbs.) of clean, soft water until a deep red liquid is obtained. Then take it off the fire, cool, strain and keep aside; the silk thread to be dyed should be mordanted with a saturated solution of alum in cold water and spread out to dry; the latter is then to be boiled in the former until it assumes a deep red colour; when cool it is to be rinsed with cold water and spread out to dry in the shade. If desired, the colour can be softened by acidulating the water with a trace of fresh lemon juice.

Manufacture of shellac.

The seed-lac obtained by washing stick-lac with water is thoroughly dried in the sun and sorted into three grades:—

I. Large granular—used exclusively for the manufacture of superior quality of shellac.

II. Small granular— } used together for the manufacture of
III. Dust— } second quality, T. N. mark, shellac.

To the granular seed-lac is then added 2 to 3 per cent. of yellow orpiment to impart colour and 4 to 5 per cent. of pine resin to lower the melting point. The whole is then thoroughly mixed and filled into long, narrow bags 10 to 12 yards long. The bag is generally made of Cawnpore Drill No. 2, selling at 10 yards per rupee, and generally contains 16 seers of mixed seed-lac. It is usually worked by two men and a boy. The boy sits at one end, twists it in one direction with an instrument called *Phirki*, while the other end is held by the expert worker who sits near an open oven. The lac within the bag melts, oozes out and falls down on the stone pavement in front of the oven. The worker then takes it up, mixes it well with a spatula and when thoroughly cooked hands it over to his assistant who puts the semi-liquid mass on a porcelain cylinder containing hot water, and spreads it out uniformly with a sheath of palm leaves. The molten lac is then carefully removed from the cylinder, warmed before a fire and ultimately drawn out into a thin sheet 5 feet long by 6 feet broad. The sheets are then put aside, and when sufficiently cool are examined for defects which are punched out by hand. The rejected portions are then

ground, mixed with seed-lac and again filled into the bags. The whole process is expeditiously and smartly done by men who mostly come from Mirzapore in the United Provinces. A worker with two assistants is capable of turning out a maund of shellac per day, for which he charges Rs. 2. The average cost of production of a maund of shellac is Rs. 10, though in some places it is considerably less.

Local and foreign uses of shellac.

Locally, shellac is principally used for the following purposes:—

(1) By goldsmiths for filling ornaments.
(2) For making bangles, marbles and toys.
(3) For making milk churns, shuttles, and bobbins.
(4) For making bracelets and sealing-wax sticks.
(5) For making grinding stones.
(6) For fixing hafts to swords, etc.

Its uses in foreign countries are:—

(1) For gramophone records.
(2) As a constituent of varnishes and polishes for furniture and metals.
(3) Sealing-wax sticks.
(4) Lithographic inks.
(5) As a stiffening for silk and straw hats.

Enemies of lac.

As has been mentioned above, in some years the crop is considerably damaged by the following pests:—

1. *Ants.*—The ants* frequent trees for the sake of the sugary excretion—technically known as "honey-dew"—exuded by the lac insects. In their eagerness to lick it up they inadvertently break off the whitish hairs which carry air to the female within the resinous cell. The result is that the host dies of suffocation and the whitish floss characteristic of healthy growth disappears.

* *Diacamma vagans*, Smith.
Crematogaster subnuda, Mayr.
Polyrhachis simplex, Mayr.
Oecophylla smaragdina, Fabr.
Myrmecocystus setipes, Forel.
Camponotus villis, Smith.
Tapinoma melanocephalum, Fabr.
Camponotus compressus, Fabr.

The cells become pitted and turn dark brown in colour. Sometimes the ants appear suddenly in numbers and if their appearance coincides with the emergence of the males, fertilisation is stopped. The ants, considering the males to be the producers of honey-dew, carry them away and prevent fertilisation.

These can easily be prevented from getting up the inoculated plants by strewing wood-ashes mixed either with crude oil emulsion (to be had of Messrs. Bathgate & Co., Calcutta, at Rs. 6-4-0 per 5-gallon drum) or phenyl, as well as by putting a band of tar or tying a piece of cloth dipped in crude oil emulsion, round the stems and branches of inoculated trees. If their nests are found in the vicinity of trees they should be dug out and destroyed. If the large brown ant is especially troublesome in any locality, the branches of neighbouring trees overhanging the inoculated trees must be removed and the ants will soon disappear.

II. *Predaceous caterpillars.*—Four kinds of caterpillars* feed on lac. Three of these appear in numbers a few days after the emergence of males in the Katiki (October-November) crop from August to September. The female moth flies at dusk and lays eggs on or between the resinous cells. The caterpillar on hatching burrows into the cell until it reaches the female which it devours. Having destroyed one it moves on to another, making subterranean passages which it lines with silk and pellets of excreta. The characteristic webbing and the presence of isolated, loose, pustule-like spots on the inoculated branches are signs of the presence of the pests. (Plate X.) If, therefore, the webbing be opened at the time with either a thorn or a sharp pointed stick, a small, whitish caterpillar with a black head will be found inside. These should be collected and destroyed. The other caterpillar also feeds on the lac insects on the trees as well as when the crop is harvested. These are small, slender greyish insects with a black head. When full-grown they pupate within the lac encrustations and a week later a tiny, dark-grey moth comes out, couples and lays eggs. The webbing usually met with in stick-lac stored in bulk for some time is the work of the caterpillar. The easiest and most effective way of saving the crop from these caterpillars is to fumigate it immediately after scraping. If, however, the quantity of stick-lac be small, it should be washed and

Eublemma coccidiphaga, Hmpsn.
Eublemma cretacea, Hmpsn.
Eublemma amabilis, Moore.
Hypatima pulverea, Mcy.

the seed-lac either stored or sold and the lac-dye used as manure. If, however, the quantity of stick-lac in hand be large, and the market rates be low at the time, it should be thoroughly dried in the shade and fumigated with carbon bisulphide before storage. For details of fumigation and the precautions to be taken while fumigating, see the Appendix (page 31).

III. *Parasites.*—Besides the ants and the predaceous caterpillars, two small, brownish insects (Family Braconidæ) and a small, black one (Family Chalcidæ) lay their eggs in the females within the resinous cells and kill them. These are especially bad in the Katiki crop and are found in small numbers in the Baisakhi crop. At present there is no method of effectively checking these beyond fumigation. (For details see Appendix, page 31.)

IV. Besides the above, men, monkeys, squirrels, fire, frost and hot winds also damage the crop to some extent, and in localities where lac cultivation is a paying industry thefts are so common that an entire crop when ready to be cut is stolen. To prevent this, guards or chowkidars have to be appointed.

Recommendations for the extension of lac cultivation.

I. Plant Ber trees on tank and field embankments, by the sides of rivers and *nallahs*, as well as in waste lands. The tree is very hardy and grows well in the poorest of soils with little care. When eight to ten years old, divide them into convenient groups, prune and inoculate them. If there be old trees in the locality, prune and inoculate them also. Careful pruning will increase their vigour and make them live long. Kusumb brood-lac may be used every four or five years to maintain vitality of the seed. If this cannot be procured, exchange seed with growers from different parts of the district to keep vitality of the local seed.

Similarly plant Palas or Dhak in waste lands, and when the plants are eight to ten years old inoculate them. Dhak grows well in very poor soils and waste land and the propagation of the lac insect does not interfere with the supply of fuel for which the tree is generally reserved.

The Kusumb tree does not grow well in the plains and is really a forest tree. It grows well at an altitude of 2,000 feet and over. There are certain localities in Northern India where this tree can be planted conveniently in regular blocks and utilised for lac growing.

It yields the healthiest and best lac and is greatly valued for this reason. Its brood-lac can be put on Ber and Palas, but not *vice versâ*. The reason is that Kusumb wood being hard, propagates a sturdy race of lac insects, which when grown on Ber and Palas gradually degenerates. These if put back on the Kusumb fail to abstract the necessary nourishment and perish.

II. As the species of the lac insect are not yet known, it is safe to extend the cultivation by putting Kusumb lac on Ber and Palas, Palas brood-lac on Palas and Ber, Peepal brood-lac on Peepal and other species of Ficus such as Pakur (*Ficus infectoria*), Bar (*Ficus bengalensis*), and Gular or Dumar (*Ficus glomerata*). Siris brood-lac should be put on Siris and Babool brood-lac on Babool. As regards Babool lac the experience in Bihar has been that, if brood-lac be obtained from Sind and put on Babool trees in Bihar, it fails to reproduce itself so as to be considered a success financially.

III. The practice hitherto in vogue of collecting lac before the emergence of the young insects for the sake of the lac-dye should be given up. The market is changed and the old order of things has been reversed with the introduction of the cheaper coal-tar colours. Lac-dye, which was formerly sold at Rs. 10 to Rs. 16 a maund, has practically to be thrown away and in consequence the manufacturers require stick-lac which is free from the colouring matter. This can be done by gathering the produce a fortnight before the emergence of the young insects and putting it on a number of pruned trees to increase the cultivation.

IV. The present system of leasing trees to contractors for a year or for a certain number of years should be modified. The lessee should be required to leave sufficient brood-lac on the trees from which the crop is gathered. If possible he should be asked to cut the crop a fortnight before the local date of emergence of the young insects and put it on a number of trees of the same kind, *viz.*, Ber on Ber and Peepal brood-lac on Peepal.

V. If the brood-lac of a locality is continuously used for five or six years for reproductive purposes it soon degenerates and the outturns are consequently poor. To mitigate this, the following measures should, if possible, be adopted:—

(1) Arrange for a mutual exchange of seed from different localities.

(2) Sell the local seed and buy instead some healthy brood-lac from a reliable grower.

(3) If possible buy Kusumb brood-lac every fourth or fifth year and put it on Kusumb, Ber or Palas trees. The crop from these is to be kept exclusively for seed.

(4) While gathering the crop, reserve healthy branches for seed. The rest that are damaged by ants, predaceous caterpillars or hot winds are to be scraped and the produce fumigated.

APPEN

** Names of trees on which lac can be grown,*

Name used in the Bulletin.	Botanical name.	Bengal.	Assam.	United Provinces.
Ber . .	*Zizyphus jujuba*, Lam.	Kūl, Bér, Bor	..	Ber, Beri .
Bar or Bargad	*Ficus bengalensis*, Linn.	Bar, But .	Ranket (Garo), Bot.	Bargad, Bar, Bargat.
Babool .	*Acacia arabica*, Willd.	Babool, Kikar, Gahur Bābla.	..	Babool, Babur.
Kusumb .	*Schleichera trijuga*, Willd.	Kusum, Kosano.	..	Kosum, Gausam, Kusum.
Palas .	*Butea frondosa*, Roxb.	Palas, Faras-Paras (Bihar).	Laho Kung (Lepcha).	Dhīk, Palas, Tesu, Kaukrai, Chichra.
Pakur . .	*Ficus infectoria*, Willd.	Pákar, Pakur.	Prab (Garo), Kangji (Lepcha).	Pakhār, Pakri, Khabar, Pakur, Pelkhan.
Peepal . .	*Ficus religiosa*, Linn.	Aswat, Asūd, Asvattha.	Bor-bur (Cachar).	Peepal . .
Siris . .	*Albizzia lebbek*, Benth.	Sirisha, Siris.	..	Siris, Siras, Sirin, Sirai.
Arhar . .	*Cajanus indicus*, Spreng.	Arhar, Oror, Orol.	Mirimah, Garo-mah.	Arhur, Tuar .
Gular . .	*Ficus glomerata*, Roxb.	Jagya Dumar, Yajna Dumar.	Tchongtay (Lepcha).	Gular, Umrai, Parosa, Umar.

* From the Dictionary of Economic Products of India, G. Watts.

DIX.

with their botanical and provincial equivalents.

Punjab.	Central Provinces.	Bombay.	Madras.
Ber, Beri .	Bher, Bori, Ringa (Gond).	Ber, Jangri (Sind). Ber, Bhor, Bordi, Bór, Bóra.	Elāndap, Yellande, Elladu, Régu, Ganga Regu, Yalachi, Yagachi.
Bera, Bor, Bohir, Bargad.	Bar, Barghat, Barelli (Gond).	War and Bur (Sind). Wad, Vad, Barghat, Vada.	Ala Mari, Peddi Mari, Ala Peralu.
Vabhula, Barbara.	Babool . .	Bahbula, Kali Kikar, Bāval (Sind).	Tūma, Nellatuma, Gobli, Karrijali.
Samma, Jamoa, Causam, Kussumb.	Kussum, Kojba	Peduman, Kosam, Kosamb, Kocham, Koshimb.	Pāvā, Pūlachi, Pumarum, Puvu, Pusku, Roatanga, Posuku.
Palas . .	Chiulha, Palas.	Palāsa, Khākāra, Khakharo, Tesuka-Jhar, Khakhado, Khakharnu-Jhada, Paras, Phalāsa-cha-Jhada.	Porasan, Parasa, Purashu, Puraishu, Palasham, Mōduga, Mohtu, Palādulu, Muttuga, Thoras, Muttaga-a-Marā.
War, Palkhi, Batbar, Pipli, Pakri.	Serilli (Gond), Pakri.	Pepar, Pipli, Pakri, Gandhaum-bara, Pepri.	Pepre, Kurku, Jooi, Jewi, Yui, Kari.
Pipal, Bhor .	Peepal . .	Pipur (Sind), Pimpal, Piplo, Pimpala.	Arase, Aswartham Rai, Raiga, Rāvi.
Siris, Siras, Sirin	Siris, Saras .	Sirus (Sind), Chichola, Mothá Siras, Pelo-sarshio.	Vaghe, Kot Vaghe, Darshan.
Arhar, Dinger, Tohar.	Arhar, Tur .	Tuvero, Túra, Tuver, Turi.	Thovaray, Tuvarai, Kandalu, Togari.
Kathgular, Rumbal, Batbar, Palāk, Dadhuri.	Umbar-gular .	Umbar, Umbara, Atti, Rumadi.	Atti, Moydi, Bodda Paidi.

Terms used in the lac trade.

Altās	Cotton-wool or fibre of Madár (*Calotropis gigantea*) soaked in concentrated lac-dye. These are generally used by Hindu women in Bengal, the United Provinces, the Punjab and parts of the Central Provinces for colouring the soles of their feet.
Button lac	An inferior grade of shellac, melted and spread into small circular, thick discs on plantain stems. This contains neither resin nor orpiment and is much used for various purposes where colour is not the object.
Chapra	Shellac.
Fine orange D. C.	A grade of shellac.
Garnet lac	A grade of shellac made from small, granular seed-lac, parings from shellac sheets, melted and drawn into thick, dark-coloured sheets.
Gund	Fine dust obtained by separating the washed seed-lac. This is mixed with *khud* for making bracelets, etc.
Kanja	Powdered stick-lac.
Kham lac	Stick-lac.
Khud	Fine dust obtained by separating ground stick-lac before washing it with water.
Kiri or Phog	Is the residuary matter left in the bag. This is obtained by boiling the rope-like twisted bags in big iron cauldrons containing an alkali.
Lac-dye	Is the colouring matter obtained by washing stick-lac with water.
Lakh Dānā	Seed-lac.
Livery leaf	A grade of shellac.
Molamma	Fine dust obtained by sifting washed seed-lac.
Morha	A twig covered with lac.
Nagli	Kusumb stick-lac.
Orange leaf	A grade of shellac.
Pank	Is the refuse collected on the cloth in straining lac-dye.
Phungi or Phunki lac	Stick-lac collected after the emergence of young insects.
Rangeen	Palas stick-lac, so-called on account of its containing a large quantity of colouring matter.

Seed-lac	Is lac obtained by soaking and washing ground stick-lac with water.
Shellac	Seed-lac mixed with resin and orpiment, cooked and drawn into thin sheets.
Sita	Lac cells from which the young insects have emerged.
Stick-lac	Lac collected either before or after the emergence of young insects.
T. N. mark	Second quality of shellac.

Fumigation of stick-lac before storage.

(From "Indian Insect Pests.")

The best method of preservation is to fumigate the stick-lac and then to store it in insect-proof bins or jars or boxes. Fumigation is the process of exposing the scraped lac to the fumes of carbon bisulphide at a proper strength for a definite period. Stick-lac exposed to the fumes of carbon bisulphide at the rate of 1 oz. per 10 cubic feet of space for 12 hours will be freed from the injurious caterpillars that spoil the resin. When large quantities are to be fumigated carbon bisulphide at the rate of one to one and a half pound per ton (27 maunds) may be used. Before pouring in the carbon bisulphide all the doors must be made air-tight. After 24 hours the fumigated stick-lac is to be taken out and aërated with a piece of muslin over it to prevent moths from again laying eggs on the fumigated material.

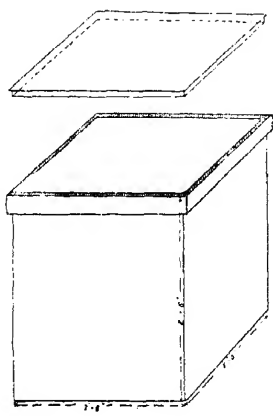


FIG. 17.
The Fumigating-box.

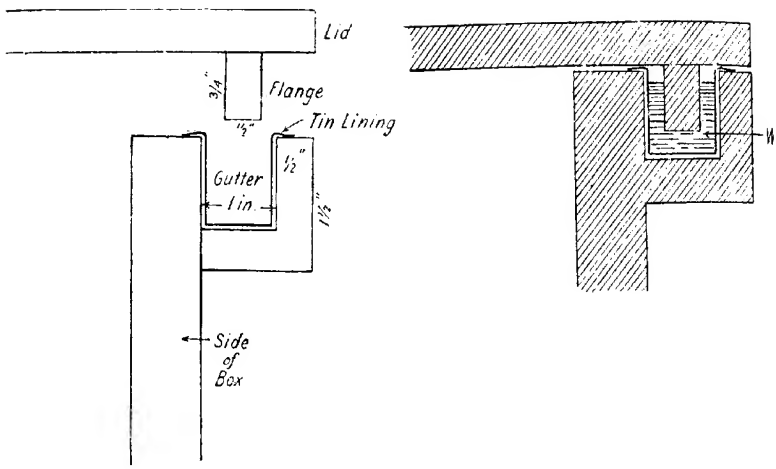


FIG. 18.

Details showing construction of the Fumigating-box.

(*a*) Tin-lined gutter and the flange.

(*b*) The lid in position with water in the gutter.

As carbon bisulphide is extremely inflammable and unpleasant to handle, the following precautions must be taken :—

(1) Keep the carbon bisulphide in stoppered (not corked) bottles under lock and key.

(2) While fumigation is going on, nobody is to be allowed to go into the room.

(3) No lights, lighted pipes or cigarettes or any form of fire must be brought near the fumigating room.

(4) If the smell of carbon bisulphide be noticed, no one should be allowed to go near with a light.

(5) Do not place a bottle of carbon bisulphide in the sunlight or in any place where it will become hot.

(6) Never take a bottle of carbon bisulphide near a fire or lighted lamp.

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